

(19)



Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

EP 1 180 784 A3

(12)

EUROPEAN PATENT APPLICATION

(88) Date of publication A3:
13.09.2006 Bulletin 2006/37

(51) Int Cl.:
H01J 37/302^(2006.01) H01J 37/317^(2006.01)

(43) Date of publication A2:
20.02.2002 Bulletin 2002/08

(21) Application number: **01119151.7**

(22) Date of filing: **08.08.2001**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE TR
 Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **10.08.2000 JP 2000243202**

(71) Applicant: **Hitachi, Ltd.**
Chiyoda-ku,
Tokyo 101-8010 (JP)

(72) Inventors:
 • **Nagata, Koji,**
Hitachi,Ltd. Intel. Prop. Grp.
Chiyoda-ku,
Tokyo 100-8220 (JP)

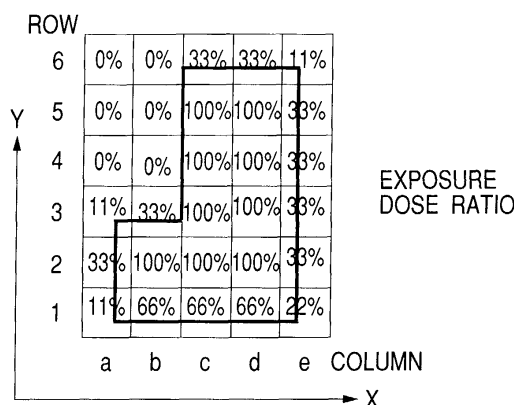
- **Yoda, Haruo,**
Hitachi,Ltd. Intel. Prop. Grp.
Chiyoda-ku,
Tokyo 100-8220 (JP)
- **Satoh, Hidetoshi,**
Hitachi,Ltd. Intel. Prop. Grp.
Chiyoda-ku,
Tokyo 100-8220 (JP)
- **Takahashi, Hiroyuki,**
Hitachi,Ltd.Intel. Prop. Grp.
Chiyoda-ku,
Tokyo 100-8220 (JP)

(74) Representative: **Strehl Schübel-Hopf & Partner**
Maximilianstrasse 54
80538 München (DE)

(54) Method and apparatus for charged particle beam exposure

(57) A plurality of circuit patterns are written by a small number of charged particle beams with a high dimension controllability without using a mask.

A desired charge quantity is irradiated on a desired point on a sample by performing irradiation on a charged particle beam section in a superposing manner in order to obtain a predetermined exposure intensity by the charged particle beams constituting a plurality of charged particle beam groups. In addition, the charged particle beams are used, in which current quantities of a plurality of the charged particle beams are made to have a weighted gradation, the desired charged quantity is irradiated, and thus a desired exposure dimension is obtained.

FIG. 9**EP 1 180 784 A3**



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 01 11 9151

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y A	WO 98/48443 A (ETEC SYSTEMS, INC) 29 October 1998 (1998-10-29) * figures 1,2 * * page 3, line 18 - page 5, line 27 * * page 7, line 10 - line 14 * * page 8, line 1 - line 7 * * page 9, line 13 - line 35 * * page 11, line 6 - line 14 * * page 12, line 1 - line 25 * * page 13, line 22 - line 27 * * page 15, line 17 - line 20 * -----	1,9,10 2,6-8, 11-13	INV. H01J37/302 H01J37/317
Y A E	PATENT ABSTRACTS OF JAPAN vol. 2000, no. 04, 31 August 2000 (2000-08-31) -& JP 2000 012438 A (CANON INC), 14 January 2000 (2000-01-14) * abstract * ----- -& US 6 657 210 B1 (MURAKI MASATO) 2 December 2003 (2003-12-02) * the whole document * -----	1 2,6,8-10 1	TECHNICAL FIELDS SEARCHED (IPC) H01J H01L G03F
Y A	YASUDA H ET AL: "MULTIELECTRON BEAM BLANKING APERTURE ARRAY SYSTEM SYNAPSE-2000" JOURNAL OF VACUUM SCIENCE AND TECHNOLOGY: PART B, AVS / AIP, MELVILLE, NEW YORK, NY, US, vol. 14, no. 6, November 1996 (1996-11), pages 3813-3820, XP000721114 ISSN: 1071-1023 * abstract * * page 3813, right-hand column * * page 3818, right-hand column * * figure 12 * * page 3819, right-hand column * ----- -/--	9,10 7,11	
5 The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 24 April 2006	Examiner Opitz-Coutureau, J
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 01 11 9151

DOCUMENTS CONSIDERED TO BE RELEVANT				
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)	
E	WO 02/13226 A (APPLIED MATERIALS, INC) 14 February 2002 (2002-02-14) * page 4, line 4 - line 27 * * page 7, line 28 - page 9, line 10 * * page 12, line 4 - line 14 * * page 15, line 3 - line 14 * -----	1,6,8		
A	CHANG T H P ET AL: "ARRAYED MINIATURE ELECTRON BEAM COLUMNS FOR HIGH THROUGHPUT SUB-100 NM LITHOGRAPHY" JOURNAL OF VACUUM SCIENCE AND TECHNOLOGY: PART B, AVS / AIP, MELVILLE, NEW YORK, NY, US, vol. 10, no. 6, 1 November 1992 (1992-11-01), pages 2743-2748, XP000332477 ISSN: 1071-1023 * abstract * * page 2743, right-hand column - page 2744, left-hand column * * figure 3 * -----	1,3,6, 8-10		
A	US 5 304 441 A (SAMUELS ET AL) 19 April 1994 (1994-04-19) * abstract *	1,3,6, 8-10		TECHNICAL FIELDS SEARCHED (IPC)
A,P	WO 00/60632 A (UT-BATTELLE, L.L.C; THOMAS, CLARENCE, E; BAYLOR, LARRY, R; VOELKL, EDG) 12 October 2000 (2000-10-12) * page 4, line 26 - line 28 * * page 16, line 10 - line 19 * * page 11, line 1 - line 31 * * page 12, line 10 - line 13 * * page 12, line 28 - page 13, line 4 * * page 14, line 1 - line 2 * * page 16, line 1 - line 19 * -----	1,9,10		
5 The present search report has been drawn up for all claims				
Place of search Munich		Date of completion of the search 24 April 2006	Examiner Opitz-Coutureau, J	
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document				

EPO FORM 1503 03.82 (P04C01)

**CLAIMS INCURRING FEES**

The present European patent application comprised at the time of filing more than ten claims.

- ☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):
- ☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

- ☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.
- ☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.
- ☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:
- ☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1,2,6-13



European Patent
Office

**LACK OF UNITY OF INVENTION
SHEET B**

Application Number

EP 01 11 9151

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1,2,6-13

Method and apparatus for charged particle beam exposure
using a plurality of charged particle beams with different
current quantities, with multiple exposure of individual
pixels

2. claims: 3-5,9-13

Method and apparatus for charged particle beam exposure
using a plurality of charged particle beams of different
intensities, with a shift register for controlling exposure
data

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 01 11 9151

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

24-04-2006

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 9848443	A	29-10-1998	TW 386248 B	01-04-2000
JP 2000012438	A	14-01-2000	US 6657210 B1	02-12-2003
US 6657210	B1	02-12-2003	JP 2000012438 A	14-01-2000
WO 0213226	A	14-02-2002	AU 8542801 A	18-02-2002
			EP 1309983 A2	14-05-2003
			JP 2004506296 T	26-02-2004
			US 6828574 B1	07-12-2004
US 5304441	A	19-04-1994	NONE	
WO 0060632	A	12-10-2000	AU 4042300 A	23-10-2000
			CN 1351756 A	29-05-2002
			JP 2002541623 T	03-12-2002
			TW 548678 B	21-08-2003